Transport Properties of Hydrofluoroolefins in the Gaseous Phase Determined by Acoustic Measurements

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Viscosity and thermal conductivity of hydrofluoroolefins refrigerants such as HFO-1234yf(2,3,3,3-tetrafluoropropene) and HFO-1234ze(E)(trans-1,3,3,3- tetrafluoropropene) in the gas phase are determined on the basis of the acoustic method. Speed-of-sound data of the hydrofluoroolefins samples, which are measured by using a spherical acoustic resonator, are fitted to the acoustic-virial equation with an intermolecular potential model such as Stockmayer potential model. Then, viscosity and thermal conductivity can be obtained from the Chapman-Enskog equation using the acoustically determined intermolecular potential parameters. Viscosity and thermal conductivity of the hydrofluofoolefins samples are also directly measured by using a cylindrical acoustic resonator. Frequency curve of an acoustic resonance in the cylindrical cavity filled with the sample gas is closely related to the transport properties of the gas sample. By measuring the half-width of the resonance curve in the longitudinal mode and the radial mode, viscosity and thermal conductivity of the sample gas can be separately determined. Viscosity and thermal conductivity data of the hydrofluoroolefins samples obtained through the above two methods are compared with the calculated values by RefProp (NIST). The claimed uncertainties by Refprop are 10% for viscosity and 5% for thermal conductivity. Most of the obtained data in the present study are agreed with the calculated values by Refprop within the above claimed uncertainties.